

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

PPH0125 –MECHANICS

(Foundation in Engineering)

14 OCTOBER 2019
02.30 p.m. - 04.30 p.m.
(2 Hours)

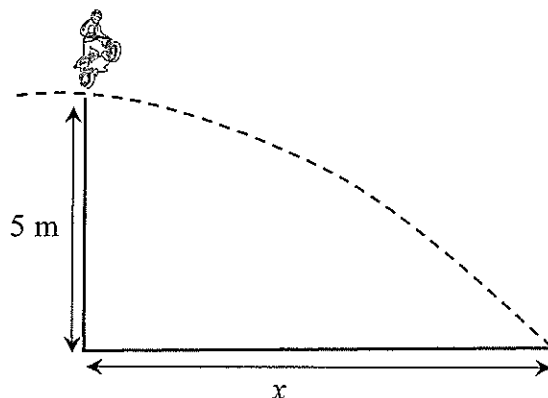
INSTRUCTIONS TO STUDENT

1. This question paper consists of 6 pages excluding the cover page with 5 Questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.
4. All necessary working steps/concept must be clearly shown.

QUESTION 1 (20%)

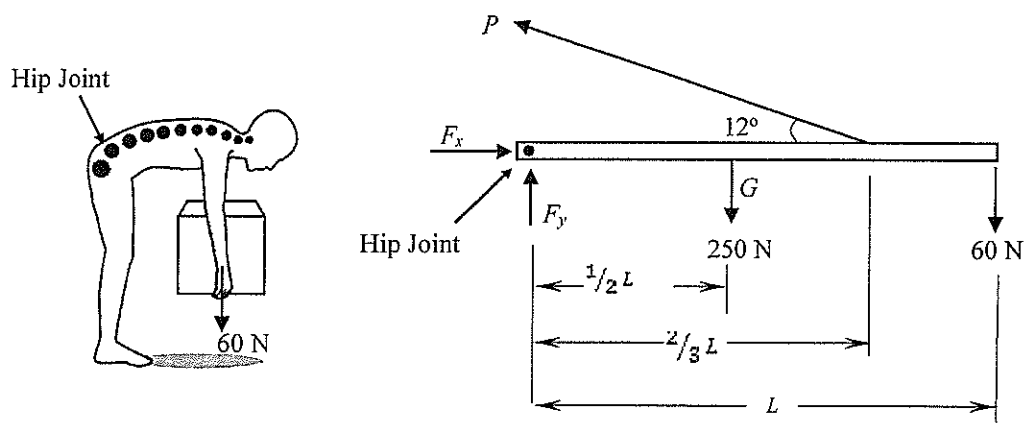
- a) In **Figure 1 (a)** shows a motorcycle rider is moving horizontally and taking off from a cliff of 5 m above the ground. Upon taking off, the velocity of the vehicle is 30 m/s. What is the horizontal distance, x , of the motorcycle when it touches the ground from the place where he took off?

(10 marks)

**Figure 1 (a)**

- b) **Figure 1(b)** shows a man is bending down to carry a 60 N load. From the figure, it can be seen that his hip joint is pivoted as he bent down. A free body diagram has been constructed to show the weight of his upper torso which weighs at 250 N and act through G point. Find

- the tension of back muscle P . (4 marks)
- the compression F_x on the back bone. (3 marks)
- the vertical reaction F_y on the hip joint. (3 marks)

**Figure 1 (b)**

Continued ...

Question 2 (20%)

- a) A particle shown in **Figure 2 (a)** move in a circle with radius 0.25 m at constant speed. It takes 5 s to move from point *A* to *B*.

- i) What is the angular distance in radians from point *A* to *A* in one cycle? How far it travels?

(2 + 2 marks)

- ii) What is the angular velocity of the particle?

(3 marks)

- iii) What is the speed of the particle when it is at point *B*?

(3 marks)

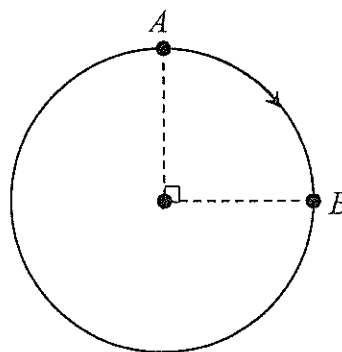


Figure 2 (a)

- b) A disk having a radius of 0.15 m rotates with initial angular velocity of 2 rad/s and has a constant angular acceleration of 1 rad/s². When $t = 2$ s, determine

- i) the magnitudes of the velocity,

[4 marks]

- ii) the magnitude of acceleration of a point on the rim of the disk.

[6 marks]

Continued ...

QUESTION 3 (20%)

Figure 3 depicts a 50 kg satellite at point *A*. Its distance from the center of the Earth is 1.5×10^9 m. Given the mass of the Sun is 2×10^{30} kg, mass of the Earth is 6×10^{24} kg and distance between the Earth and the Sun is 1.5×10^{11} m. Calculate

- a) the gravitational pull of the Earth on the satellite. (4 marks)
- b) the gravitational pull of the Sun on the satellite. (4 marks)
- c) the magnitude and the direction of the resultant force of the satellite. (4 marks)
- d) the acceleration of the satellite. (3 marks)
- e) the period of the satellite orbits the Sun to the nearest year. (5 marks)

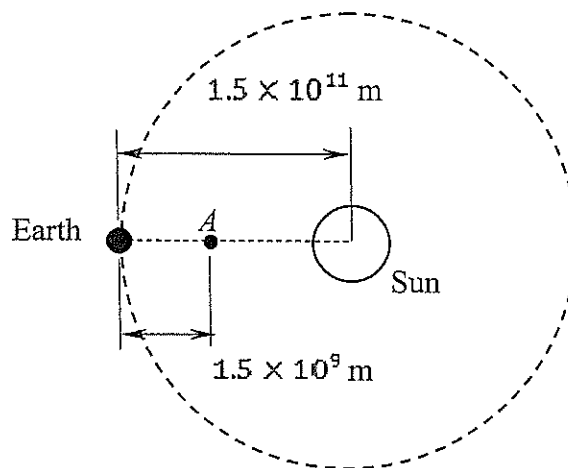


Figure 3

Continued ...

QUESTION 4 (20%)

Figure 4 shows a wire of length 0.5 m is fixed horizontally between two supports at 0.5 m apart. When a mass of 7.5 kg hung onto midpoint of the line, the wire sags by 10 mm.

- Find the total extension of the wire. (5 marks)
- Express the tension, T , of the wire in terms of mass, m , gravity, g , and angle, θ . (5 marks)
- Given the diameter of the wire is 2.8 mm, what is the Young's modulus of the wire? (10 marks)

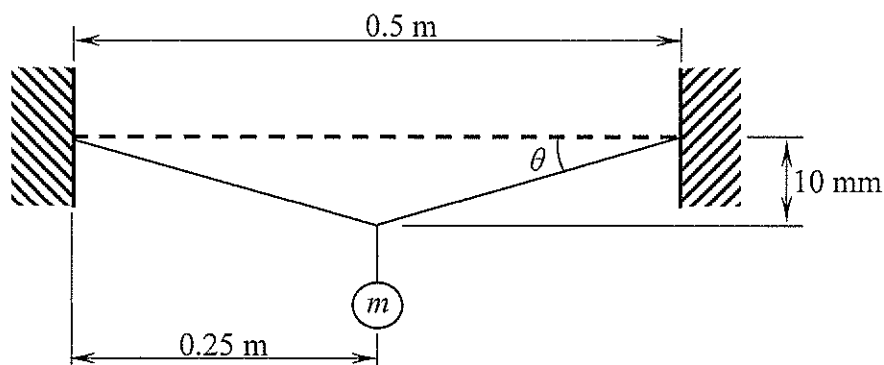


Figure 4

QUESTION 5 (20%)

A 50.0 g object connected to a spring with a spring constant of 35.0 N/m oscillates on a horizontal, frictionless surface with amplitude of 4.00 cm. Find

- The total energy of the system, (4 marks)
- The speed of the object when its position is 1.00 cm. (6 marks)
- The kinetic energy of the object when its position is 3.00 cm. (6 marks)
- The potential energy stored in the spring when the position of the object is 3.00 cm. (4 marks)

Continued ...

APPENDIX 1**Physical Constants**

Quantity	Symbol	Value
Electron mass	m_e	$9.11 \times 10^{-31} \text{ kg}$
Proton mass,	m_p	$1.67 \times 10^{-27} \text{ kg}$
Elementary charge	e	$1.602 \times 10^{-19} \text{ C}$
Gravitational constant	G	$6.67 \times 10^{-11} \text{ N.m}^2/\text{kg}^2$
Gas constant	R	8.314 J/K.mol
Hydrogen ground state	E_0	-13.6 eV
Boltzmann's constant	k_B	$1.38 \times 10^{-23} \text{ J/K}$
Compton wavelength	λ_c	$2.426 \times 10^{-12} \text{ m}$
Planck's constant	h	$6.626 \times 10^{-34} \text{ J.s}$
Speed of light in vacuum	c	$3.0 \times 10^8 \text{ m/s}$
Rydberg constant	R_H	$1.097 \times 10^7 \text{ m}^{-1}$
Acceleration due to gravity,	g	9.8 m/s^2
Atomic mass unit (1u)	u	$1.66 \times 10^{-27} \text{ kg}$
Avogadro's number	N_A	$6.023 \times 10^{23} \text{ mol}^{-1}$
Threshold of intensity of hearing	I_0	$1.0 \times 10^{-12} \text{ W/m}^2$
Coulomb constant	k	$9.0 \times 10^9 \text{ N.m}^2/\text{C}^2$
Permittivity of free space	ϵ_0/κ_0	$8.85 \times 10^{-12} \text{ C}^2/\text{N.m}^2$
Permeability of free space	μ_0	$4\pi \times 10^{-7} \text{ H/m}$

Energy equivalent of atomic mass unit:

One atomic mass unit (1.0 u) is equivalent to 931.5 MeV

Earth:

Gravity	=	9.8 m/s^2
Radius	=	$6.4 \times 10^6 \text{ m}$
Mass	=	$6.0 \times 10^{24} \text{ kg}$

Moon:

Mass	=	$7.4 \times 10^{22} \text{ kg}$
Radius	=	$1.7 \times 10^6 \text{ m}$

Sun:

Mass	=	$2.0 \times 10^{30} \text{ kg}$
Radius	=	$6.96 \times 10^8 \text{ m}$

Mean distance from:

Sun to Earth	=	$1.50 \times 10^{11} \text{ m}$
Moon to Earth	=	$3.85 \times 10^8 \text{ m}$

Continued...

APPENDIX 2**List of formulas**

$y = kx^n$ $\frac{dy}{dx} = knx^{n-1}$	$\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}}$ $\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}}$ $\tan \theta = \frac{\text{opposite}}{\text{adjacent}}$ $\sin \alpha + \sin \beta = 2 \cos \left(\frac{\alpha - \beta}{2} \right) \sin \left(\frac{\alpha + \beta}{2} \right)$ $\sin(\alpha - \beta) + \sin(\alpha + \beta) = 2 \sin \alpha \cos \beta$
$v = v_o + gt$ $y - y_o = \left(\frac{v_o + v}{2} \right) t$ $a_o = \frac{v^2}{r}$ $\tau = r \times F$ $v = r \omega$ $L = r \times p = I \omega$	$y - y_o = v_o t + \frac{1}{2} g t^2$ $v^2 = v_o^2 + 2g(y - y_o)$ $F_g = G \frac{m_1 m_2}{r^2}$ $U_g = -G \frac{m_1 m_2}{r}$ $T^2 = K_s r^3$ $\sum \tau = \tau_{net} = I \alpha$ $I = \sum m r^2$ $K = \frac{1}{2} I \omega^2$ $ \tau = r F \sin \theta$ $T_s = 2\pi \sqrt{\frac{m}{k}}$ $T_p = 2\pi \sqrt{\frac{l}{g}}$ $T = \frac{2\pi}{\omega} = \frac{1}{f}$ $\bar{y} = \frac{\sum_{i=1}^N m_i y_i}{\sum_{i=1}^N m_i}$ $x = A \cos \omega t$ $x = A \sin \omega t$ $v = -\omega A \sin \omega t$ $v = \omega A \cos \omega t$ $W_F = r F \cos \theta$ $a = -\omega^2 A \cos \omega t$ $a = -\omega^2 A \sin \omega t$ $v = \frac{\Delta x}{\Delta t}$ $a = \frac{\Delta v}{\Delta t}$ $v = v_o + at$ $x - x_o = v_o t + \frac{1}{2} a t^2$ $v^2 = v_o^2 + 2a(x - x_o)$ $x - x_o = \left(\frac{v_o + v}{2} \right) t$ $W = mg$ $\sum F = F_{net} = ma$ $f_s \leq \mu_s F_N$ $f_k = \mu_k F_N$ $p = mv$ $\sum F = \frac{\Delta p}{\Delta t}$ $\Sigma W = \frac{1}{2} m v^2 - \frac{1}{2} m u^2$ $m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$ $m_1 u_1 + m_2 u_2 = (m_1 + m_2) v$ $P = \frac{W}{t} = \frac{E}{t} = \frac{Fd}{t} = F \bar{v}$ $K = \frac{1}{2} m v^2$ $PE_s = \frac{1}{2} k x^2$ $F_s = -kx$ $PE_g = mgy$ $\bar{x} = \frac{\sum_{i=1}^N m_i x_i}{\sum_{i=1}^N m_i}$ $W_{Fs} = \frac{1}{2} k x_i^2 - \frac{1}{2} k x_f^2$

End of Paper.